CORRELATIONS OF COSMICAL AND MOLECULAR FORCE.

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If it be granted

1. That all forms of terrestrial organic energy are transformed modifications of solar radiation ;
2. That centrifugal and centripetal energies tend continually to equilibrium ;
3. That the kinetic energy of a perfectly elastic medium under constant pressure, bears a definable ratio to its kinetic energy under constant volume ;

Then the *kinetic energy of dissociated water should be, approximately, to the kinetic energy of terrestrial revolution, as the mass of the earth, is to the mass of the sun.*

And *the energy of hydrocarbons should be, approximately, to the energy of dissociated water, as elastic energy under constant volume, is to elastic energy under constant pressure.*

For the measures, of the energy of gaseous combustion, and of the energy of orbital revolution, are, respectively, the mean height of oscillation excited by the igneous energy of the combustible compound, and the mean distance from the sun at which the earth is sustained in its orbital revolution. It is evident, from the well known laws of elasticity, that if a perfectly elastic body were lifted, *in vacuo*, to any given height, and then let fall, it would rebound to the height from which it fell, and this oscillation would be perpetual, unless disturbed by extraneous forces, in the same way, and for a similar reason, that the earth continues its elliptical oscillation about the sun. Inasmuch as the total radiating force is considered in each instance, [the time consumed in storing up and in liberating the accumulated solar energy being left entirely out of question,] the element of velocity is not involved in the preliminary determination. It may, however, be subsequently ascertained, if desired, by the formula, $v=\sqrt{2\,gh}$.

It is evident that the dissociated oxygen and hydrogen tend to expand, in consequence of any liberated interior energy, under constant exterior pressure, while the hydrocarbons are restrained by the cohesive forces which tend to maintain a constant volume.

For the purpose of testing the accordance, both of the postulates and of the conclusions, with the facts of observation and experiment, it might be deemed sufficient to confine attention exclusively to the lightest and most elastic gas, and to the lightest and most volatile liquid. But I believe the same principles, with simple modifications, are applicable to all forms of matter, and I have already extended the investigation, with some encouraging results, to inorganic elements and compounds. I subjoin, from Muspratt's Chemistry, all the elements and products involved

in the unstable equilibria of organic life, for which I have been able to find any recorded experimental value. In all cases which have been tested by more than one observer, the kinetic ratios represent the mean of all the latest and most authentic results. For convenience of expression, I employ the following symbols:

d=length of terrestrial day.

y'=duration of orbital revolution of the earth.

y''= " " " " the moon.

y'''= " " " " a hypothetical satellite at the surface of the earth.

g=32.0874377 feet.

r=radius of the earth=20,923,654 feet.

$c', c'' \ldots c_{xvi}$ = combustible (hydrogen, ether, ... carbon).

$\gamma_x(\gamma' \gamma'' \ldots \gamma_{xvi})$=product of combustion.

$t_x\ (t', t'' \ldots t_{xvi})$=thermal units, or number of pounds of water heated 1° C. by the combustion of 1 pound of c_x

J=Joule's equivalent, $\frac{193}{1320}$ mile—pounds.

w_x=weight of $\gamma_x \div$ weight of c_x.

r_i'=mean height at which the earth is suspended under the centrifugal force of the sun.

r_i''= " " " moon " " centrifugal force of the earth.

h_x=mean height at which γ_x would be suspended, in the oscillation maintained by combustion and gravitation=$J \times t_x \div 2w_x$.

$r_i' \div h_x = \mu_x$, approximation to solar mass in units of earth's mass, furnished by c_x.

k_x=kinetic ratio of $c_x = \mu_x \div \mu'$

ρ_x=ratio of experimental to theoretical value of k_x.

m', m'', m'''=mass of sun, earth, moon.

	c_x	Symbol.	γx	k_x	ρx	Authorities *
1	Hydrogen	H	HO	1.000	1.000	D, H, G, F&S, A
2	Ether	C_4H_5O	$4CO_2$,5HO	1.494	1.004	D., F&S.
3	Olive Oil	$C_{10}H_8O$	$10CO_2$,8HO	1.495	1.004	D.
4	Terebene	$C_{10}H_8$	$10CO_2$,8HO	1.503	1.010	F&S.
5	Marsh Gas	CH_2	CO_2,2HO	1.518	1.020	D., G., A., F&S.
6	Amylic Ether	$C_{10}H_{11}O$	$10CO_2$,11HO	1.521	1.022	F&S.
7	Phosphorus	P	PO_5	1.529	1.027	A.
8	Olefiant Gas	CH	CO_2,HO	1.534	1.030	D., G., F&S., A.
9	Oil of Turpentine	C_5H_4	$5CO_2$,4HO	1.542	1.036	G., F&S.
10	Oil of Lemons	$C_{10}H_8$	$10CO_2$,8HO	1.545	1.038	F&S.
11	Fusel Oil	$C_{10}H_{12}O_2$	$10CO_2$,12HO	1.596	1.072	F&S.

* A., Andrews. D., Dulong. F&S., Favre and Silbermann. G., Grassi. H., Hess. I reject Dalton's determinations of k_x for camphor (2.808), because in nearly every instance he obtained much higher values than any later experimenters. Further experiments with that substance ($C_{10}H_8O$, yielding $10CO_2$,8HO) would be interesting, and perhaps suggestive.

12 Alcohol	$C_4H_6O_2$	$4CO_2,6HO$	1.601	1.076	D., G., F&S., A.
13 Cyanogen	C_2N	$2CO_2,N$	1.647	1.106	D.
14 Acetone	C_3H_3O	$3CO_2,3HO$	1.681	1.129	F&S.
15 Wood Spirit	$C_2H_4O_2$	$2CO_2,4HO$	1.722	1.157	G., F&S.
16 Carbon	C	CO_2	1.853	1.245	D., G., H.

The following examples indicate the manner in which the several values are determined :

$$h'=J\times t'\div 2w'=\frac{193}{1320}\times\frac{34533}{2\times 9}=280.5 \text{ miles.*}$$

$$h_{\text{xi}}=J\times t_{\text{xi}}\div 2w_{\text{xi}}=\frac{193}{1320}\times\frac{8959\times 11}{2\times 41}=175.7 \text{ ``}$$

$$k_{\text{xi}}=h_{\text{xi}}\div h_1=1.596$$

If an elastic fluid is lifted above the earth's surface, subject to the (nearly) constant pressure of gravity, the superficial pressure varies as $\left(\frac{r+h}{r}\right)^2$, and the volume as $\left(\frac{r+h}{r}\right)^3$. The value of h for HO being, as we have seen, 561 miles (or twice h_1, which represents the *mean* height of oscillation), if we call r (earth's mean radius) 3956 miles, $\left(\frac{r+h}{r}\right)^3=1.4886$. This corresponds approximately to the experimental valuation adopted by Tyndall (1.421), and is almost identical with the experimental kinetic ratio of ether (1.494).

$y'''=2\pi\sqrt{r\div g}=5074$ seconds.

$y''=27$ dys, 7 h., 43 min. 12 s.

$\eta''=(y''\div y')^{\frac{2}{3}}\times r=237937$ miles.

By my hypothesis,

$$h' : \eta' :: m'' : m' \quad \therefore m'=m''\frac{\eta'}{h'}$$

And, according to well known mechanical laws,

$$m'=m''\left(\frac{\eta}{r}\right)^3+\left(\frac{y'''}{y'}\right)^2$$

Solving the equations, we obtain the following values :

Sun's mass 330,260

" distance 92,639,500 miles.

* If e represents the extreme excursion of the exploded gases, the centre of gyration, considering the earth's surface as the axis, being $\frac{2e}{3}$, the secondary centre of oscillation, on the return towards the centre $\frac{e}{2}$, is at $\frac{5e}{9}$, and $\frac{5}{9}$ of 34533° C.=34533° F.